Project: Organic anion-mineral surface interactions: In situ measurements of weathering.

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Objective: The general focus of this project is mineral surface geochemistry. The specific focus is organic acid interactions with mineral surfaces.

Results: New measurements of pH and ionic strength-dependent proton and hydroxyl adsorption onto kaolinite points to specific binding at edge Al and Si sites, and can be modeled as a function of temperature with a triple layer model (TLM) of the mineral-solution interface. Exchange of Al for protons and hydroxyls is observed at low pH, with a stoichiometry approaching 1:3 (Al:H^+) (see Figure 1). Adsorption of organic acids from dilute solutions depends on: (1) solution pH; (2) the functionality of the acid; and to a lesser extent, (3) temperature. Such adsorption may occur primarily at Al sites exposed on kaolinite edges, as indicated by sorption experiments on the constituent oxides, where negligible sorption was observed on SiO_2 (quartz), but was significant on Al_2O_3 (corundum) surfaces. Under similar conditions, oxalate adsorbs more strongly than acetate or formate to aluminol sites.

Significance: These results show that the pH-dependent surface charge of kaolinite can be represented with a TLM, whereas organic acid adsorption cannot. Also, oxalate, and other organic acid, sorption occurs primarily at exposed aluminol (edge) sites. Finally, Al^{3+} - H^+ exchange appears to be stoichiometric for exposed Al edge sites in kaolinite.

Publication: A journal article entitled "Effect of Al and Organic Acids on the Surface Chemistry of Kaolinite" has been written by D. B. Ward and P. V. Brady P and is published in Clay and Clay Minerals, 46, No. 4, 453-465, 1998.
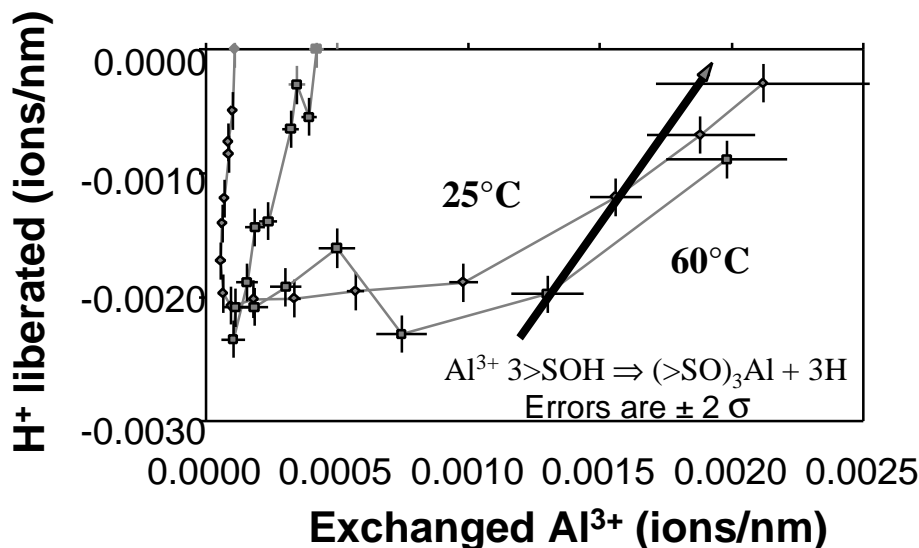

Figure 1. Proton/Aluminum Exchange on Kaolinite